

# **Real-time flu prediction may be possible using wearable heart rate and sleep tracking devices**

January 17 2020

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First study to evaluate de-identified data from wearable devices on resting heart rate and sleep finds improved real-time prediction of influenza-like illness in five US states compared to current surveillance methods.

The research, published in *The Lancet Digital Health* journal, demonstrates the potential of [data](#) from [wearable devices](#) to improve surveillance of infectious disease. Resting [heart rate](#) tends to spike during infectious episodes and this is captured by wearable devices such as smartwatches and fitness trackers, that track heart rate. De-identified data from 47,249 Fitbit users, retrospectively identifies weeks with elevated resting heart rate and changes to routine sleep. Further prospective studies will need to be done to help differentiate between infectious versus non-infectious forecasting.

Influenza results in 650,000 deaths worldwide annually. Approximately 7% of working adults and 20% of children aged under five years get flu each year. Traditional surveillance reporting takes 1-3 weeks to report, which limits the ability to enact quick outbreak response measures—such as ensuring patients stay at home, wash hands, and deploying antivirals and vaccines.

Past studies using crowdsourced data, such as Google Flu Trends and Twitter have found variable success on their own as these methods tend to overestimate rates during epidemics. This is because it is impossible to separate out the activity of individuals with influenza from heightened awareness or related to media during flu season.

Study author Dr. Jennifer Radin, Scripps Research Translational Institute, USA, says: "Responding more quickly to influenza outbreaks can prevent further spread and infection, and we were curious to see if [sensor data](#) could improve real-time surveillance at the state level. We demonstrate the potential for metrics from wearable devices to enhance

flu surveillance and consequently improve public health responses. In the future as these devices improve, and with access to 24/7 real-time data, it may be possible to identify rates of influenza on a daily instead of weekly basis."

The researchers reviewed de-identified data from 200,000 users who wore a Fitbit wearable device that tracks users' activity, heart rate and sleep for at least 60 days during the study time from March 2016 to March 2018. From the 200,000, 47,248 users from California, Texas, New York, Illinois and Pennsylvania wore a Fitbit device consistently during the study period, resulting in a total of 13,342,651 daily measurements evaluated. The average user was 43 years old and 60% were female. All Fitbit users, including those whose data are included in this study, are notified that their de-identified data could potentially be used for research in the Fitbit Privacy Policy.

Users' average resting heart rate and sleep duration were calculated, as well as deviations to this to help identify when these measures were outside of an individual's typical range (ie, using standard deviation). During each week, a user was identified as abnormal if their weekly average resting heart rate was above their overall average (by more than a half or a full standard deviation) and their weekly average sleep was not below their overall average (by more than half a standard deviation). The users were arranged by which state they lived in, and the proportion of users above the threshold each week was calculated. This data was compared to weekly estimates for influenza-like illness rates reported by the U.S. Centers for Disease Control (CDC).

By incorporating data from Fitbit trackers, influenza predictions at the state level were improved. In all five states there was an improvement in real-time surveillance, and the closest alignment with CDC data was found when abnormal resting heart rate was defined as half a standard deviation above normal and sleep more than half a standard deviation



below.

This is the first time heart rate trackers and sleep data have been used to predict flu, or any infectious disease, in real-time. With greater volumes of data it may be possible to apply the method to more geographically refined areas, such as county or city-level.

The authors identify several limitations in their study. A general lack of activity data meant they could not control for seasonal fitness changes or more short-term activity changes. Weekly resting heart rate averages may include days when an individual is both sick and not sick, and this may result in underestimation of illness by lowering the weekly averages. Other factors may also increase resting [heart](#) rate, including stress or other infections. Lastly, the authors note that previous studies of sleep measuring devices have been found to have low accuracy, though the authors note that accuracy will continue to improve as technology evolves.

In the study, the Fitbit users were predominantly middle age adults and likely higher income than the [general population](#) so potentially less likely to suffer comorbidities which could make them more susceptible to severe infections. They also may be more likely to get influenza vaccines or receive antivirals or other medicines if they do get sick which can reduce disease severity, so the models may need to be modified for use in other populations.

In a linked Comment article, Dr. Cécile Viboud of the Fogarty International Center, National Institutes of Health, USA, says: "The study by Radin et al is a promising first step towards integrating wearable measurements in predictive models of infectious diseases. [...] we anticipate that the large amount of real-time data generated by Fitbit and other personal devices will prove highly useful for public health and augment traditional surveillance systems. The ever expanding "big data"

revolution offers unique opportunities to mine new data streams, identify epidemiologically-relevant patterns, and enrich infectious disease forecasts."

**More information:** Jennifer M Radin et al, Harnessing wearable device data to improve state-level real-time surveillance of influenza-like illness in the USA: a population-based study, *The Lancet Digital Health* (2020). [DOI: 10.1016/S2589-7500\(19\)30222-5](https://doi.org/10.1016/S2589-7500(19)30222-5)

Provided by Lancet

Citation: Real-time flu prediction may be possible using wearable heart rate and sleep tracking devices (2020, January 17) retrieved 2 May 2024 from <https://medicalxpress.com/news/2020-01-real-time-flu-wearable-heart-tracking.html>

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